MODIS DATA SYSTEM STUDY TEAM PRESENTATION

April 21, 1989

AGENDA

1. Digital Terrain Data Availability
2. EosDIS/MODIS Data System Interface Comparison
3. MODIS Core Data Products and Data Flows (wall display)
4. MODIS Team Member Proposed Data Products and Data Flows (wall display)

DIGITAL ELEVATION PRODUCTS

Jim Heirtzler was contacted for sources of digital elevation data. He is aware of only one global digital elevation data set which is distributed through the National Geophysical Data Center in Boulder, Colorado. The contact at this data center is Dr. Herbert Meyers (303) 497-6521. Dr. Meyers is on leave and could not be contacted at this time.

According to Heirtzler this global data base is on a 5' X 5' lat/lon grid (9.3 km at the equator with increasing resolution toward the poles). He stated that although this data base has been updated since he first helped put it together, there are still some problems with it (especially towards the poles).

Defense Mapping Agency (contact: Dr. Benny Klock (703) 756-9340) collects data at a spacing of 300 feet (100m) in areas where information has been requested by the military. For this reason they do not have global coverag data, however they do have data for a large percent of the globe.

They will send a catalogue of data products that includes maps of regional coverage in response to a standard written request from a person representing a government agency. The catalogue is entitled Digital Data Catalogue Part 7. Allow 6 to 8 weeks for delivery. This request should be mailed to

Headquarters Defense Mapping Agency
Attention: PR
8613 Lee Highway
Fairfax, VA 22031-2137

Level 1 - DTED is one of their standard products that covers roughly 50% of the world at a resolution of 3 arc seconds (92m at the equator). By 1992 or 1993 they plan to have a DTED level 2 product in production that has a resolution of 1 arc second (.31m at the equator).

I inquired about information on ocean elevation. The person who would know about this was out of the office until next week so she will be contacted next week.

Dave Harding (286-4849) who is working in Code 622 at GSFC has been gathering detailed information on DMA data bases. He is concentrating on the level-2 DTED (horizontal resolution of 100m and vertical resolution of 30m). These data are available for several regions of the world. At the present resolution, data are stored on 72 tapes. Again location informatio will be available in the Digital Data Catalogue part 7. Harding mentioned that he has the catalogue which can be viewed by government officials.

It is necessary to set up a project number to transfer information/funds between GSFC and DMA. One has already been set up through Code 622 at GSFC Dave Harding has details on this information.

DIGITAL TERRAIN ELEVATION DATA (DTED) – LEVEL 1

SUMMARY: A uniform matrix of terrain elevation values. Provides basic quantitative data for all military training, planning, and operating systems that require terrain elevation, slope, and/or surface roughness information.

PRODUCT SPECIFICATION: DMA Product Specifications for Digital Terrain Elevation Data, Second Edition, April 1986 (PS/1CD/200,PS/1CF/200).

DATA DENSITY: The information content is approximately equivalent to the contour information represented on 1:250,000 scale maps. Exploitation at larger scales must consider each individual cell's accuracy evaluation.

COORDINATE REFERENCE SYSTEM: Geographic

DATUM: Horizontal – World Geodetic System (WGS)
Vertical – Mean Sea Level (MSL)

CONTENT: Each cell header record provides identification, administrative data, and information (parameters) required for the application, maintenance, and verification of the elevation values. Each Elevation Data Record contains 1201 elevation values (meters) along a single meridian. A cell will have 201 to 1201 Elevation Data Records depending upon the appropriate latitude zone. Elevations are spaced in accordance with the following table:

Zone	Latitude	Spacing Lat/Long
I	0° – 50° N-S	3 by 3 arc seconds
II	50° – 70° N-S	3 by 6 arc seconds
III	70° – 75° N-S	3 by 9 arc seconds
IV	75° – 80° N-S	3 by 12 arc seconds
V	80° – 90° N-S	3 by 18 arc seconds

STRUCTURE: Matrix

FORMAT: ASCII labeled variable length records. (See product specifications for details.)

MEDIA: 9 track, 1600 or 6250 CPI, 1/2 inch magnetic tape.

For additional information contact:
Director
DMA Combat Support Center
ATTN: PMA
Washington, DC 20315-0010

AUTOVON: 287-2495
COM: (301) 227-2495
1-800-826-0342
Telex: 710-824-0293

STANDARD FILE SIZE: 1° by 1° geographic cell identified by its southwest corner coordinates.

ACCURACY:

Accuracy statements are individually calculated for every product and provided in the Accuracy Header Record. Using our best sources, the accuracy evaluations typically are in the following ranges:

Absolute Horizontal	25 to 35 meters at 90 percent circular error
Point-to-Point Horizontal	15 to 30 meters at 90 percent circular error
Absolute Vertical	± 25 to 30 meters at 90 percent linear error
Point-to-Point Vertical	± 20 to 25 meters at 90 percent linear error

DMA Product Specifications accuracy objectives for DTED-1 are:

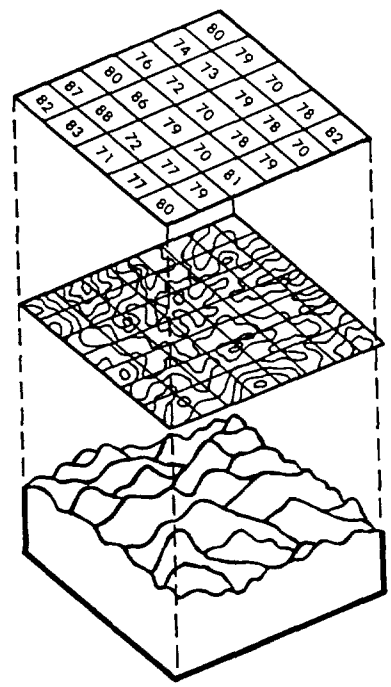
Absolute Horizontal	130 meters at 90 percent circular error
Absolute Vertical	± 30 meters at 90 percent linear error

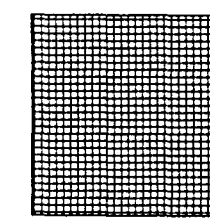
AREA COVERAGE: See DMA Catalog, Part 7 – Digital Data Products, Volume I – Terrain and Feature Data (CATP7V01). This volume is revised semiannually.

APPLICATIONS: DTED initially supported applications modeling the influence of terrain on radar line-of-sight and the appearance of radar return scenes. The success of this concept led to the widespread exploitation of DTED in virtually every type of aircraft flight simulator now in use.

Level 1 DTED are now accepted as the basic medium resolution elevation data source for all military activities and systems that require landform, slope, elevation, and/or terrain roughness information in a digital format. Within DMA, these same data can be exploited to support automated map and chart production activities.

DISTRIBUTION POLICY: DISTRIBUTION OF THESE DATA AND CATP7V01 IS LIMITED TO AGENCIES WITHIN THE EXECUTIVE BRANCH OF THE U.S. GOVERNMENT AND QUALIFIED CONTRACTORS.



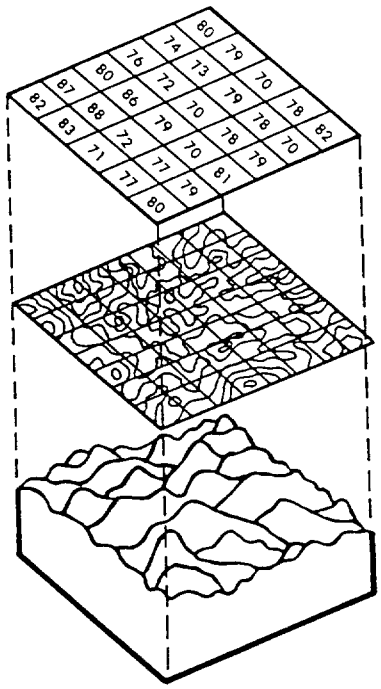


DATA CONTENT = ELEVATIONS (METERS) LATITUDE/LONGITUDE

DATA FORMAT = MATRIX

DATA FILE = 1 DEGREE CELL

DATA RECORD = ELEVATIONS VALUES S TO N SAME LONGITUDE

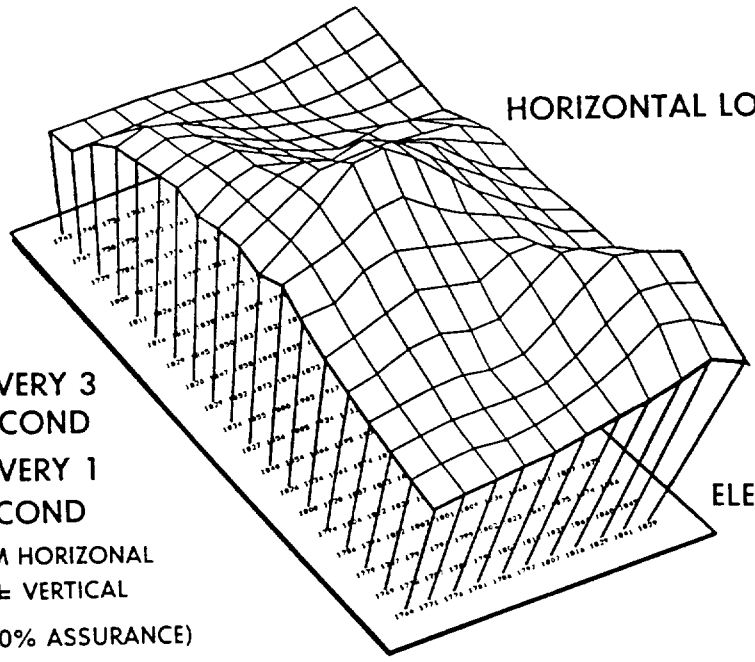


- LEVEL 1 - POST EVERY 3 ARC SECOND
- LEVEL 2 - POST EVERY 1 ARC SECOND

SPEC ACCURACY - 130 M HORIZONTAL
30 M ± VERTICAL

ABSOLUTE TO WGS - 72 (90% ASSURANCE)

DIGITAL TERRAIN DATA



- LEVEL 1 - POST EVERY 3 ARC SECOND
- LEVEL 2 - POST EVERY 1 ARC SECOND

SPEC ACCURACY - 130 M HORIZONAL
30 ± VERTICAL

ABSOLUTE TO WGS - (90% ASSURANCE)

EOSDIS/MODIS INTERFACE COMPARISON

PRELIMINARY DRAFT

1. INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

The Earth Observing System (Eos) Data and Information System (EosDIS) is the data system that is being developed to support the earth observing instruments in the Eos program. As a preliminary to the development of the EosDIS, several of the Eos instruments were selected for preliminary data system studies that could provide requirements definition in a single-instrument environment without the complexity that attends multiple instruments and multiple-instrument data products. One of the instruments selected for these early studies was the MOderate-resolution Imaging Spectrometer (MODIS).

In the year or so since these studies began, Phase B development of the EosDIS has begun in earnest and some early documents are now available from this undertaking, including the EosDIS Interface Definition Document that is reviewed in this document. It is naturally of interest to compare the data flows and system functionality developed in the EosDIS effort with the corresponding items developed earlier in the MODIS data system study. Such a comparison is useful to identify omissions that may have occurred in one or the other systems, and it also provides a natural check of EosDIS functionality against MODIS requirements. The objective of this comparison is to identify data flow differences at the element interfaces, and where appropriate, to identify differences in system response and functionality that result from the interface differences.

The results of the MODIS data system study are referred to in this document as the MODIS plan. This plan was derived from early versions of the EosDIS baseline plans and from science team member requirements.

This document is divided into two sections. The first section contains background information and a summary of data system differences. The second section provides a detailed comparison of the individual interfaces and comprises the major substance of this document. Appendix A provides a list of acronyms, Appendix B contains the MODIS data flow diagrams used in this study, and Appendix C provides a connectivity diagram and relevant interface description tables from the EosDIS Interface Definition Document.

1.2 PURPOSE AND SCOPE

This document is an addendum to the EosDIS Interface Definition Document (Reference 1), the MODIS Data Requirements Document (Reference 2) and the MODIS Information, Data, and Control System Functional Requirements Document (Reference 3). It provides a

comparison of interfaces between the MODIS-unique portions of the EosDIS and corresponding MODIS elements defined in the MODIS data system study. To the extent that data system function is reflected in interface definitions, it identifies and discusses the data system functional differences that are inherent in the individual design approaches.

The MODIS data flows used in this comparison have been defined in greater detail than the corresponding EosDIS elements. Updates to this comparison will be appropriate as the EosDIS design is established in greater detail.

1.3 MAJOR SOURCES OF DIFFERENCES

The fundamental data system issues that were identified as a result of the interface comparison are as follows:

1.3.1 Instrument Calibration

One of the ICC functions defined in the EosDIS Interface Definition Document is the oversight of all calibration functions, "including modifications to the instrument tables (either on the platform or ground)" or changes to calibration parameters, and including "complete documentation for all actions taken". The MODIS plan places responsibility for the calibration function among the TMCFs and specifically, with the Instrument Calibration Team (ICT) located at the GSFC TMCF node. Except for calibration command generation, instrument calibration occurs independently of ICC activities. Section 2.2 discusses this matter in greater detail.

1.3.2 Team Leader - Team Member Interaction

The MODIS plan assigns an important role to the team leader as the director of instrument and data processing operations. To support this role, the MODIS plan provides several interfaces between the IST and other ground system elements and outside users. The EosDIS Interface Definition Document shows only a single IST interface (with the ICC). Another functional difference indirectly involving the role of the team leader has to do with the reporting of data anomalies. The EosDIS interfaces show a link from the TMCF to the ICC for the reporting of these events. Sections 2.1.2, 2.2.1, and 2.2.5 provide detailed discussions of these differences.

1.3.3 Data Quality Assessment

The direction of information flow is reversed in several of the TMCF interfaces shown in the two plans. By the MODIS plan, data quality assessment is routinely executed at the CDHF and is reported to the TMCF. By the EosDIS plan, quality assessment is done at the TMCF and is reported to the CDHF. Section 2.4.1 discusses these differences.

Table 3.2.3.2-1. IST Interfaces

Interface Element	Function	Interface Node *	Information Transferred
ICC	Payload monitoring, scheduling, and control	6-5	Command requests, information requests
		5-6	Payload status, command iterations, engineering data, and acknowledgements

* Refer to Figure 1.2-1

3.2.4 Centralized Data Handling Facilities (CDHF)

Functioning as a component of the Active Archives along with the Data Archive and Distribution System (DADS) facilities, the CDHFs will process Level 0 data from one or more PI or research facility instruments into Level 1 - 4 data products using algorithms provided by the PI and/or science team member(s). Depending on their location and the nature of the support provided, the CDHF functions will be project or institutional responsibilities; support will likely be provided at multiple locations.

3.2.4.1 Functions

The central function of the CDHFs will be the processing of Eos instrument data into data products. The primary inputs to the CDHFs are Level 0 data and their associated ancillary data which are provided by the DHC. These data are processed into Level 1 through Level 4 data products which are routinely forwarded to the DADS facilities for short-term archive and to be made available to the science community. Information about the data sets such as catalogs and directories as well as processing status will be provided to the IMC. In addition to routine data product generation, the CDHFs support data reprocessing, special request processing, and near-real-time processing. The CDHFs interface closely with the DADS facilities and the PICFs, TMCFs, and IICFs in the performance of these functions.

3.2.4.2 Interfaces

The EosDIS-unique internal CDHF interfaces identified in Figure 1.2-1 are defined in Table 3.2.4.2-1 below.

Table 3.2.2.2-1. ICC Interfaces

Interface Element	Function	Interface Node *	Information Transferred
EMOC	Planning and scheduling	5-4	Planning information and iterations
		4-5	Science guidelines, platform resource allocation, approved schedule
	Command link	5-4	Command loads and overview information
		4-5	Command receipt, acknowledgement, and command review information
IST	Payload monitoring, scheduling, and control	5-6	Payload status, command iterations, engineering data, and acknowledgements
		6-5	Command requests and information requests
PICF	Payload calibration	5-9	Calibration requirements, parameters
		9-5	Data anomalies, acknowledgement
TMCF	Payload calibration	5-10	Calibration requirements
		10-5	Data anomalies, acknowledgement
IMC	Information/status update	5-12	Information/status/data requests
		12-5	Information

* Refer to Figure 1.2-1

3.2.3.2 Interfaces

The EosDIS-unique internal IST interfaces identified in Figure 1.2-1 are defined in Table 3.2.3.2-1 below.

Table 3.2.7.2-1. TMCF Interfaces

Interface Element	Function	Interface Node*	Information Transferred
ICC	Payload calibration	10-5	Data anomalies, acknowledgement
		5-10	Calibration requirements, parameters
CDHF	Data exchange	10-7	Data requests
		7-10	L0-4 data
	Data set production	10-7	Algorithms, calibration coefficients
		7-10	Receipt acknowledgement
	Data quality assessment	10-7	Quality assessment data
		7-10	QA data requests/ acknowledgements
DADS	Data exchange	10-8	Algorithms, calibration coefficients, data requests, management information
		8-10	L1-L4 data, receipt acknowledgement
	Data set production	10-8	Higher level data sets
		8-10	Receipt acknowledgement
IMC	Data exchange	10-12	Metadata, catalog and directory information
		12-10	Requests and receipt acknowledgement, in-situ data
	Information/status update	10-12	Information/status
		12-10	Receipt acknowledgement

* Refer to Figure 1.2-1

Table 3.2.4.2-1. CDHF Interfaces

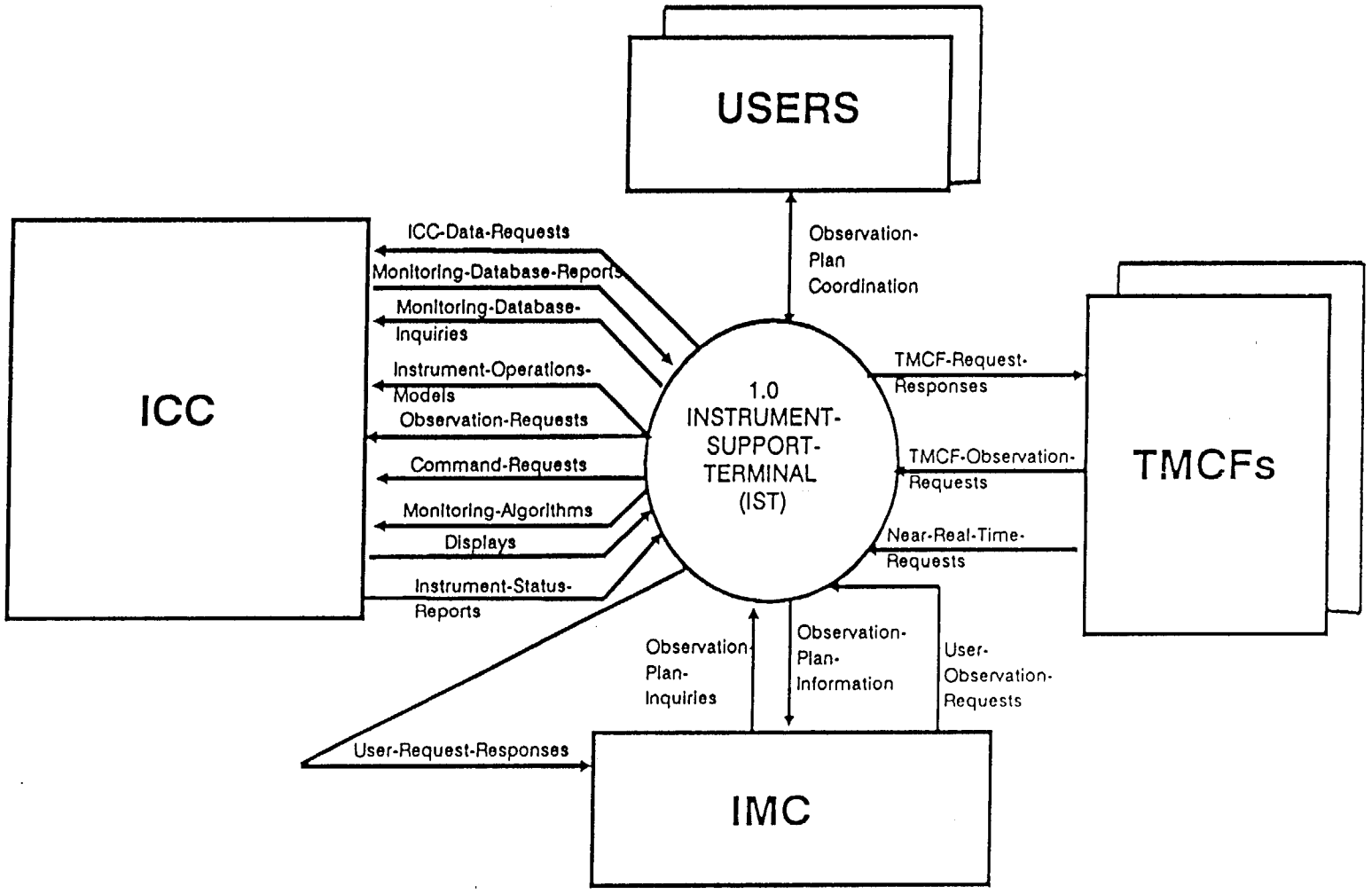
Interface Element	Function	Interface Node*	Information Transferred
DADS	Temporary storage/data exchange for reprocessing	7-8	L0-L4 data, ack.
		8-7	L0-L4 data, ack.
PICF	Data exchange	7-9	L0-L4 data
		9-7	Data requests
	Data set production	7-9	Receipt acknowledgement
		9-7	Algorithms, calibration coefficients
	Data quality assessment	7-9	QA data requests/ack.
		9-7	Quality assessment data
TMCF	Data exchange	7-10	L0-L4 data
		10-7	Data requests
	Data set production	7-10	Receipt acknowledgement
		10-7	Algorithms, calibration coefficients
	Data quality assessment	7-10	QA data requests/ack.
		10-7	Quality assessment data
IICF	Data exchange	7-11	L0-L4 data
		11-7	Data requests, ack.
IMC	Data exchange	7-12	Metadata, catalog and directory information, accounting data
		12-7	Data access requests
	Information/status update	7-12	Status and production information
		12-7	System/element status, data schedule

* Refer to Figure 1.2-1

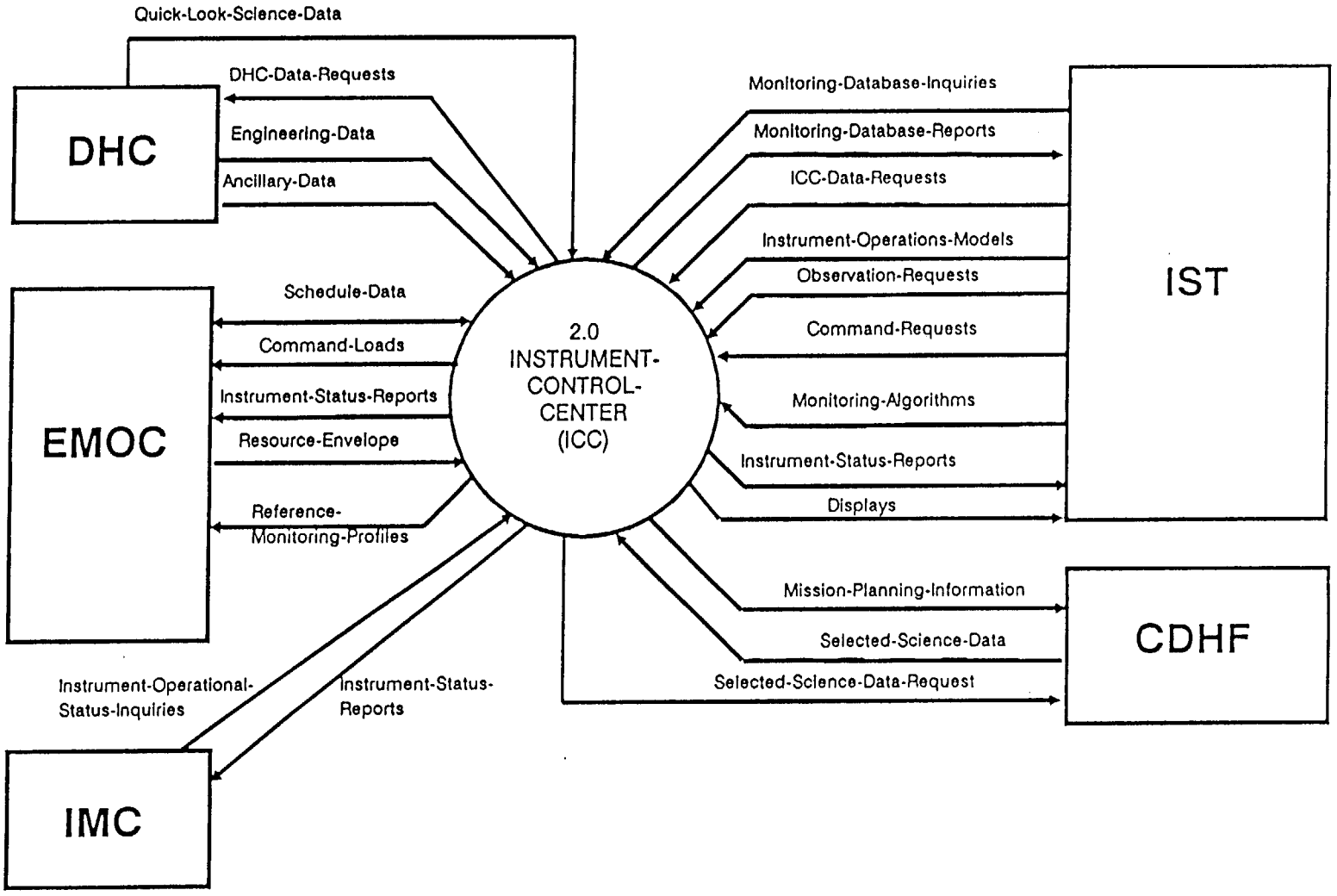
Table 3.2.5.2-1. DADS Interfaces

Interface Element	Function	Interface Node*	Information Transferred
CDHF	Data exchange for reprocessing/temporary storage	8-7	L0-L4 data
		7-8	L0-L4 data
PICF	Data exchange	8-9	L1-L4 data, receipt acknowledgement
		9-8	Algorithms, calibration coefficients, data requests, management information
	Data set production	8-9	Receipt acknowledgement
		9-8	Higher level data sets
TMCF	Data exchange	8-10	L1-L4 data, receipt acknowledgement
		10-8	Algorithms, calibration coefficients, data requests, management information
	Data set production	8-10	Receipt acknowledgement
		10-8	Higher level data sets
IICF	Data exchange	8-11	L1-L4 data, receipt acknowledgement
		11-8	Algorithms/coefficients, data requests, management information
	Data set production	8-11	Receipt acknowledgement
		11-8	Higher level data sets
IMC	Data exchange	8-12	Metadata, catalog and directory information, accounting data
		12-8	Data access requests
	Information/status update	8-12	Status and data storage information
		12-8	System/element status

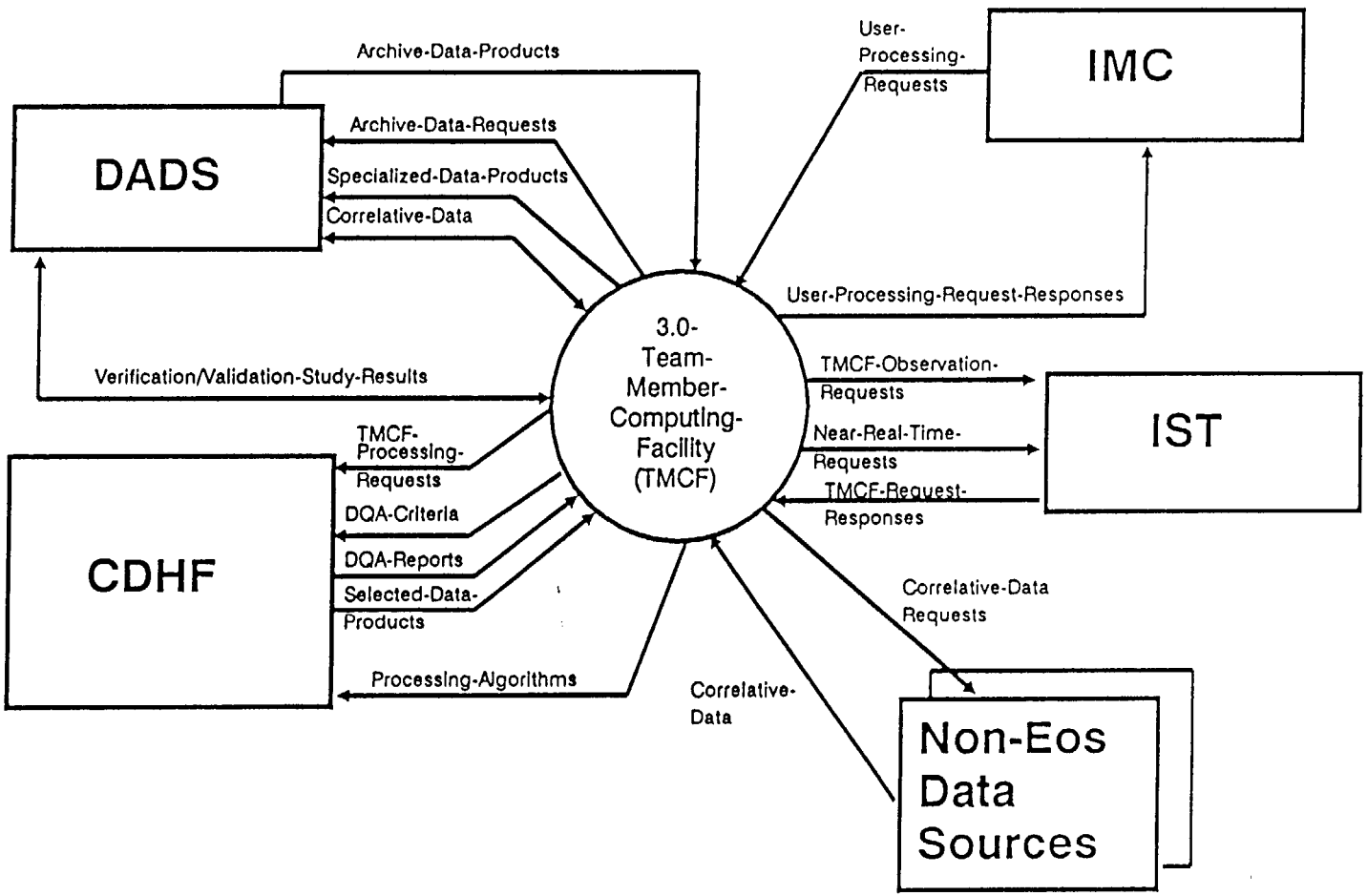
* Refer to Figure 1.2-1



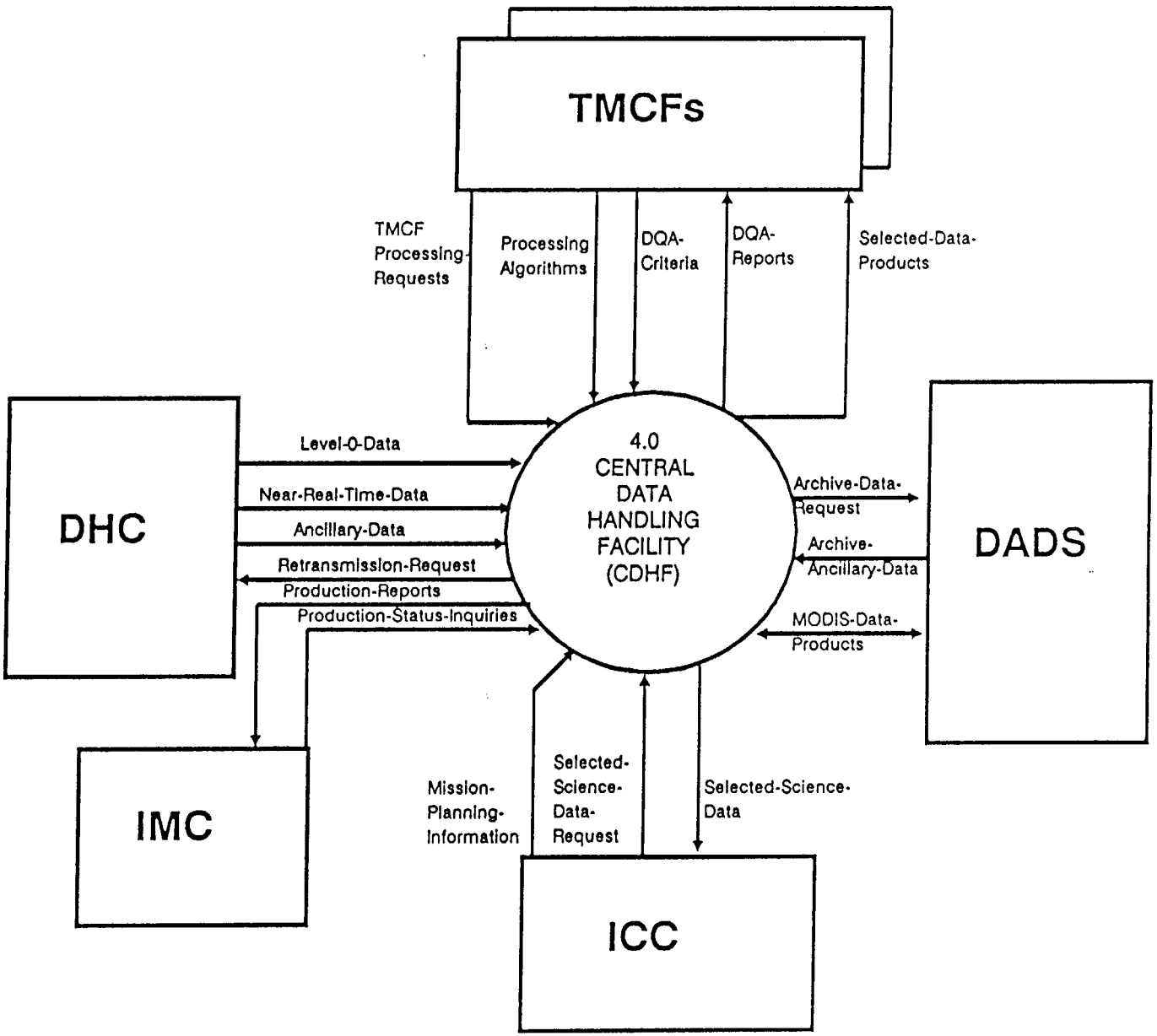
IST Context Diagram



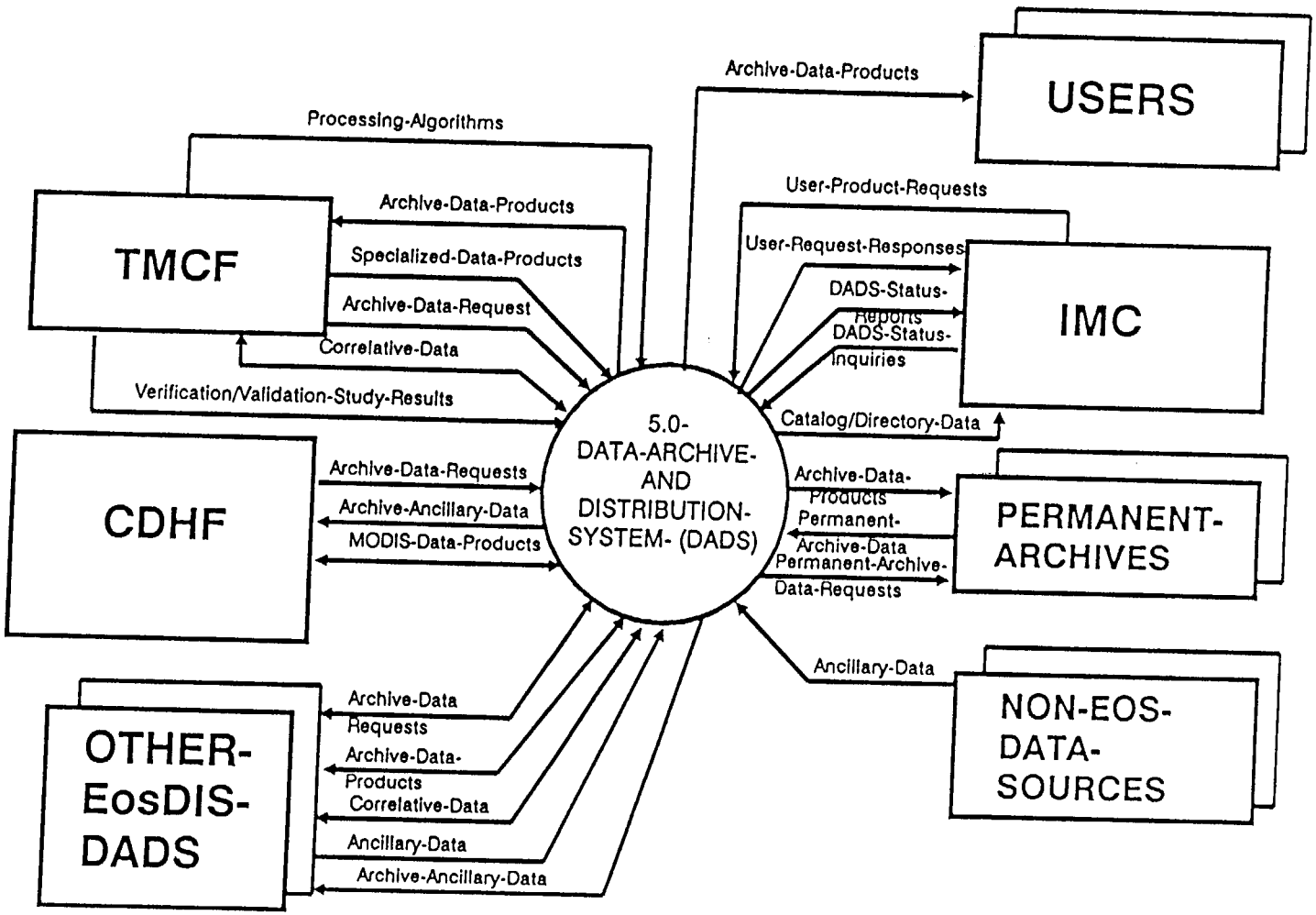
ICC Context Diagram



TMCF Context Diagram



CDHF Context Diagram



DADS Context Diagram